A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

SEPTEMBER 1971

N.B.S.

NATIONAL BUREAU OF STANDARDS

Technical News Bulletin

I recommend

— That the United States change to the International Metric System deliberately and carefully;

— That this be done through a coordinated national program;

— That the Congress establish a target date 10 years ahead;

— That there be a firm Government commitment to this goal.

MAURICE H. STANS
Secretary of Commerce

UNITED STATES DEPARTMENT OF COMMERCE

U.S. METRIC STUDY

NATIONAL BUREAU OF STANDARDS

Technical News Bulletin

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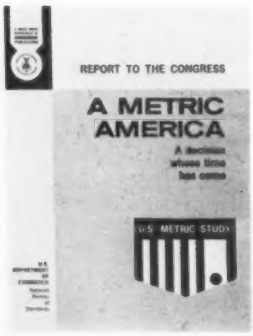

Cover: On July 30, 1971, Secretary of Commerce Maurice H. Stans transmitted to Congress the Report on the U.S. Metric Study, which was conducted by NBS. The quotations on the cover are taken from the Secretary's letter of transmittal. See page 222 for further details.

The National Bureau of Standards serves as a focal point in the Federal Government for assuring maximum application of the physical and engineering sciences to the advancement of technology in industry and commerce. For this purpose, the Bureau is organized as follows:

The Institute for Basic Standards

The Institute for Materials Research

The Institute for Applied Technology

Center for Radiation Research

Center for Computer Sciences and Technology

The TECHNICAL NEWS BULLETIN is published to keep science and industry informed regarding the technical programs, accomplishments, and activities of NBS.

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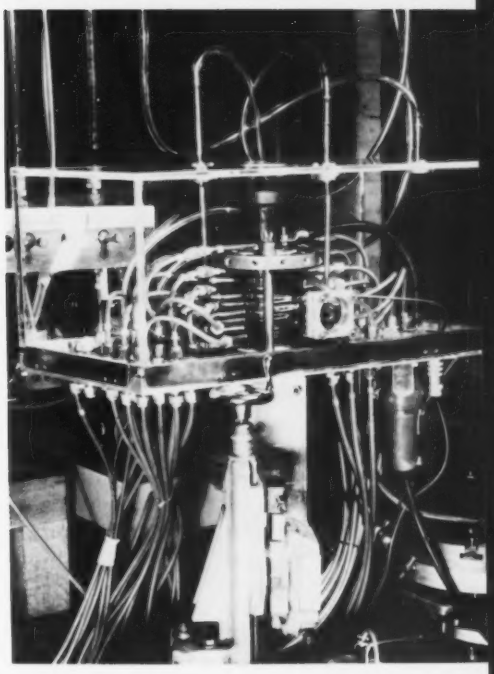
RED SHIFTS, WHITE DWARFS, AND THE STARK EFFECT



The red shift in hydrogen was analyzed from spectra obtained from the wall-stabilized arc discharge source enclosed within the glass box. Tubes to the source plates provide circulating cooling water and steady gas flow. The light beam exits through the box's window at center right.

ACCURATE LABORATORY MEASUREMENTS may modify current understanding of white dwarf stars. W. L. Wiese and D. E. Kelleher of the Optical Physics Division have determined that a significant portion of the red shift of light coming from hydrogen in white dwarfs is related to interatomic Stark broadening.[1] Astronomers have attributed the observed red shift to gravitational effects of the star from which the light is coming. The finding that gravity plays a smaller part in the red shift implies that the mass of the white dwarfs is smaller or the volume is greater than had been thought—a finding likely to have a significant impact on theories of stellar evolution.

Using a wall-stabilized arc plasma source, Wiese and Kelleher made accurate measurements of the Balmer line profiles of hydrogen. In the course of this study they found for the first time systematic slight shifts of the lines to the red portion of the spectrum, the shifts being a linear function of the plasma electron densities.

Since the electron densities (10^{16}-10^{17} electrons per cm^3) used in these experiments approximate those calculated for white dwarf stars, one must assume that some of the red shift observed from white dwarfs is Stark-induced. For example, the measured red shift of the Balmer gamma line from typical DA white dwarfs is 0.9 Å. The laboratory measurement of red shift in a plasma of the same effective electron density is 0.2 Å, reducing the red shift attributable to gravity to 0.7 Å.

White dwarfs represent the last stage in the life cycle of a star. Their nuclear fuel has been expended, and the remaining materials have condensed into a core of tremendous density. It has been estimated that the central core of a white dwarf might weigh as much as 40 tons per cubic inch.

Einstein predicted the existence of a red shift—the phenomenon whereby a photon emitted from a strong gravitational field suffers a slight shift to a longer wavelength, the amount of the shift being a function of the mass of the body from which it is emitted. Astronomers had until now attributed all of the red shift observed from white dwarf stars to this gravitational shift. It was the magnitude of the red shift, assumed to be due entirely to gravity, that was used to calculate the mass of these stars. This calculation must now be reconsidered.

Johannes Stark in 1913 discovered that spectral lines were split when the source was exposed to an electric field. In the case of hot gases, like the white dwarf stellar atmospheres, the electric field is an internal one, arising from the electrons and ions of the stellar material itself. This interatomic field is strongly inhomogeneous, causing a broadening rather than splitting of the lines.

[1] For more complete details, see Wiese, W. L., and Kelleher, D. E., On the cause of the red shifts in white dwarf spectra, Astrophys. J. Letters to the Editor **166**, No. 2, L 59 (June 1971).

SAFETY OF ULTRASONIC AMALGAM CONDENSATION QUESTIONED

IN WORK SPONSORED by the American Dental Association, H. H. Chandler, N. W. Rupp, and G. C. Paffenbarger[1] investigated the effects of ultrasonic condensation on dental amalgam. These studies revealed that an aerosol cloud was emitted from the area of the working tip during condensation. Although the mercury vapor concentration was determined to be below the accepted toxicity level, the dispersion of mercury droplets and fine, partially amalgamated alloy particles would result in the deposition of numerous fine droplets of mercury throughout the dental operatory; this in turn could cause a high level of vapor, especially if the mercury droplets were disturbed. Whether toxic levels would be reached is not known, but the use of ultrasonic devices for amalgam condensation is not advised until the safety of the instruments for this purpose has been firmly established.

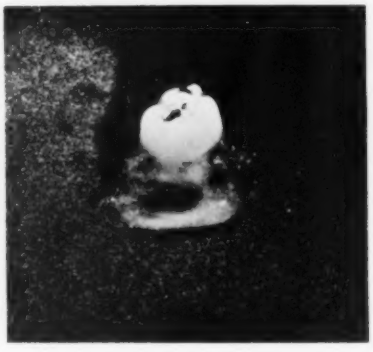
Although the ultrasonic devices examined were primarily intended for the cleaning of calcium deposits or tartar from the teeth, amalgam-condensing tips have been sold for use with this prophylaxis equipment. It is this use of the equipment that was found to be unsatisfactory. When the tip of the ultrasonic condenser was applied to the wall of a cavity prepared in an extracted or porcelain tooth or the side of the steel die during compaction of amalgam, a cloud of material was emitted. In some cases, the cloud rose as high as 60 to 90 cm. The nature of this cloud and the amount of mercury vapor in the surrounding area were determined. The amalgam restorations compacted using these ultrasonic devices were not considered to be an improvement on the condensations prepared using hand or conventional mechanical instruments.

The working tip of the ultrasonic device used in this study had a measured frequency of 24 850 ± 150 Hz and an amplitude of 0.9 ± 0.1 thousandths of an inch. Maximum water cooling and a medium power setting were used with an amalgam condensing insert. Amalgam mixes were prepared with commercially available alloys at a 1:1 mercury-to-alloy ratio. A suction device containing an in-line filter was held 7 cm above the operating area to collect sample material from the aerosol cloud. The intake hose of a vapor detector was placed 30 cm from the working tip to simulate operator-to-tooth distance. The amalgam mixes for vapor detection were condensed for three minutes in a steel die containing a 4 × 8 mm cylindrical mold.

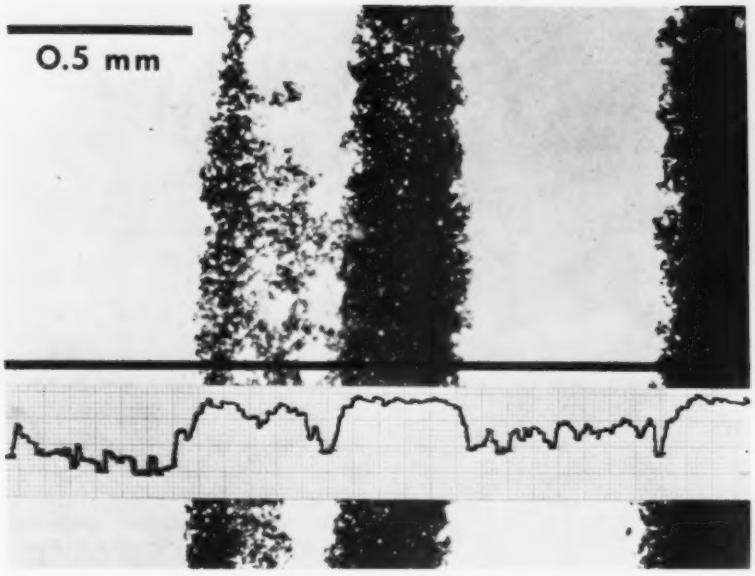
The material collected was determined to be composed of ~1 to 100 μm diameter spheres of mercury and numerous alloy particles. It is assumed that the spheres of mercury contained some dissolved alloy and that the alloy particles were reacted partially with mercury. Tests for mercury vapor revealed little vapor in the air drawn into the intake hose of the detector when the opening was 30 cm from the working area. The highest reading obtained at 30 cm was 0.02 mg Hg/m^3 of air during ultrasonic condensation. This represents 20% of the threshold limit value of 0.1 mg Hg/m^3 of air as established by the American Conference of Governmental Industrial Hygienists. The vapor levels were about zero when methods of condensation other than ultrasonic were used. Vapor levels above the threshold limit were ob-

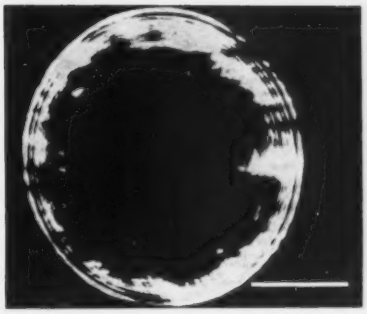
(Continued page 234)

Cloud of material being emitted from amalgam at tip of ultrasonic amalgam condensing instrument. Particles settle on instrument handle and may be responsible for some of the haze surrounding the handle.



Porcelain tooth and surrounding operating field after condensation of three amalgam mixes into tooth. Background is plain black paper. The "grainy" appearance of the background results from the great number of mercury and alloy particles that have been deposited around operating site. Dark area behind tooth is a shadow caused by oblique lighting used in making photograph.





Laser burn pattern (above) on a black lead-potassium-silicate glass. High energy regions of the beam cause surface damage on the polished surface. Undamaged area is black, lesions are white. Laser pulse was produced by a neodymium glass laser and has a nominal energy of 30 joules. Bar indicates 1 cm.

Detail of laser induced surface damage of glass and corresponding potassium distribution curve.

SURFACE DAMAGE OF LASER EXPOSED GLASS

UNDER PARTIAL SPONSORSHIP OF THE ADVANCED RESEARCH PROJECTS AGENCY, DoD, investigations of surface lesions produced by gigawatt laser pulses on black alkali-lead-silicate glass were conducted by W. Haller and N. N. Winogradoff[1] of the Institute for Materials Research. They found that the explosive release of alkali oxide vapors from the shock-molten glass causes lesions which, macroscopically, resemble thermal spall fractures. The burn pattern consists of circular, concentric bands of roughened regions in the glass surface. Nonuniform energy distribution in the laser beam caused by wave mode interference produces this particular pattern. Small glass fragments are emitted from the lesioned area in the course of the damage process.

Knowledge of cross-sectional distribution of the intensity in laser beams is of importance in many aspects of laser use and research. It is customary to monitor such power distributions by so-called "burn patterns" which are produced by focusing a laser beam on exposed photographic paper, black-insulation tape or similar absorbing material, or by scanning the cross-section with an array of small photo detectors. Laser research conducted at NBS showed that certain types of black, polished glass plates are particularly well suited to record the power distribution in gigawatt laser pulses. The burn patterns produced on such plates are characterized by excellent resolution.

Because of the success of this method and because of the importance of glass as a material in laser technology, the mechanism of the burn pattern produced on the glass surface was investigated. The laser lesions were first examined in the scanning electron microscope. They showed many rounded edges and deep craters which suggested that the damage was caused by shock melting and the explosive release of gas or vapor and not, as may have been suspected, by a thermal microfracturing "spall" of the glass surface.

To verify this hypothesis, the surface of the glass was examined by an electron microprobe technique. The major constituents of the glass were silica, lead, and potassium. The concentration profiles for lead and silica across the glass surface were found to be substantially constant and not affected by the laser-induced burn patterns. The concentration of potassium, however, decreased significantly in the regions of the burn pattern. In a lesion caused by shock melting and explosive vapor release it would be expected that the damaged glass surface would become relatively depleted in one of its chemical constituents. The excellent correlation between the visible lesions and the recorded decrease in potassium concentration is consistent with the postulated mechanism.

[1] Haller, W. and Winogradoff, N. N., Explosive vapor release as cause of laser induced surface damage of glass, J. Am. Cer. Soc., 314-315 (June 1971).

Gloria Bolotsky (left) and Zella Ruthberg watch as Roy Saltman indicates a point on an overlay of an Operational Navigational Chart.

COMPUTER PROGRAM SELECTS CHARTS AND PLOTS DATA

A TRIO OF COMPUTER SYSTEMS ANALYSTS at the Center for Computer Sciences and Technology (CCST) has written a computer program that selects the appropriate chart and directs an *x-y* plotter in marking locations given as geographical coordinates. Zella Ruthberg, Gloria Bolotsky, and Roy Saltman developed this program for the Defense Communications Agency (the DCA), to enable it to mark these points on overlays to be placed on Operational Navigational Charts (ONC maps). The sponsor needed this program for studying alternative locations of communication network nodes, but it can be used also by other groups employing ONC maps.

The DCA asked the Systems Development Division of CCST to develop a computer programming package that could be used to plot sites on over 300 ONC maps covering the land masses and islands of the earth, for comparing the geographic suitability of alternate locations for the network nodes. The sites were actually to be marked on transparent overlays, one overlay to match each navigational map used.

The NBS team developed a program called SIPLOT to plot any number of points for which latitude and longitude were given in arbitrary order on input punched cards. SIPLOT was written in the FORTRAN IV computer language for use with an IBM 360/65 computer. In operation the computer determines the map containing each point given and calculates the position of the point on the map. It sorts the points into groups according to the map used. It then drives an attached *x-y* plotter to plot each point on an overlay in one of four colors and, if desired, to number it, to draw a symbol above it, and to enclose it in one to three circles of user-determined radius. A different overlay is used for each map.

Distortion of the charts due to printing and paper shrinkage are well within the error limits needed for ordinary chart use but not for the uses of the sponsor. Errors resulting from this source were measured by finding the differences between the tabulated values of carefully chosen coordinates and the actual values of these same coordinates on that chart. A programmed first-order correction was used to compensate for the shrinkage error and for the smaller relative error resulting from drift in the plotter setting.

"SOFT COPY" CONFERENCE AND WORKSHOP HELD AT NBS

The expression "soft copy" has come into vogue recently as a contrast to "hard copy," which implies a printed message of some sort on paper or similar retainable medium. Soft copy is a transient presentation which can be either visual, as on a TV-like display, or aural, as an automatic voice response. Soft copy relates to the "paperless society" and the means to present computer-based information to people, either with or without an optional hard copy.

Soft-copy terminal devices for computer-based systems are appearing on the market in increasing numbers, creating a chaotic situation. It is evident that there is a real need for a set of standardized practices and conventions to allow the user of the equipment to converse, via keyboards and automated answerback, with a wide range of systems to meet his different needs, or his similar needs with different but similar-purpose systems. To help meet this need for standards, the National Bureau of Standards (Center for Computer Sciences and Technology, Office of Information Processing Standards) and the Society for Information Display cosponsored a Soft Copy Conference and Workshop, held at NBS, Gaithersburg, Maryland, on October 6-7, 1970. This Conference and Workshop brought together users and manufacturers of transient displays, both visual (created on the face of a television-like tube) and aural (produced by a telephone or loudspeaker). An attempt was made to establish sets of uniform conventions, practices and proposed standards for controlling soft copy terminals.

The opening session consisted of lectures describing current types of displays, and outlined problem areas to give the attendees a background for the discussion to follow. Talks were given by industry spokesmen on "Touchtone" information systems, on the state-of-the-art of display devices, and on the state of display standards in the ANSI X3 ad hoc Committee on Display Parameters. The balance of the program was devoted to Workshops, including report outlining and presentation at the final session. Workshops were held on the following subjects: control functions for which standards are needed; practices for which standards are needed; human factors important to the formulation of standards; and audio response conventions.

The subjects covered by this Soft Copy Conference are of importance both to industry and to Government, as well as the general public who will ultimately be the main users of soft copy terminal devices at home, at school, and at work. Industry needs the standards to build compatible and interchangeable equipment, whose use can be taught meaningfully for a wide range of applications.

The "Proceedings of the Soft Copy Conference" are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22151 at a cost of $3. Refer to Accession Number COM 71-00724 (Microfiche 95 cents).

DISPLAY CONTROL FUNCTIONS

In addition to hosting the Soft Copy Conference, the NBS Center for Computer Sciences and Technology has continued to pursue solutions to the problems of soft copy devices in other meetings and conferences sponsored by the Institute of Electrical and Electronics Engineers (IEEE), the Society for Information Display (SID), the ANSI X3 ad hoc Committee on Display Parameters, and the ANSI X3L2 Technical Committee on Interchange Codes. As a result of this joint activity, a proposed set of control functions for display terminals has evolved. These functions are given below in two sections.

In the list of functions the abbreviation "ESC" represents the ASCII character "Escape," and the notation 4/1 indicates Column 4, Row 1 in the 7-bit ASCII code table. The notation 08/1 indicates Column 8, Row 1 in an 8-bit code table, where the double-digit column number distinguishes the notation from the single-digit column number used in ASCII.

All of the proposed functions are represented as 2-character "Escape sequences" in ASCII, while the more frequently expected functions are assigned to single-character control positions in a proposed 8-bit code, in a manner consistent with proposed code extension rules being developed by ANSI Technical Committee X3L2 and in ISO Technical Committee 97, Subcommittee 2, (ISO/TC97/SC2).

The single-character 8-bit functions are shown in figure 1 as they would appear in a proposed standard 8-bit code along with the 128 ASCII characters. Three extra characters, ESO, ESI, and EO are also shown, standing for "Extended Shift Out," "Extended Shift In," and "Eight Ones." ESO and ESI are proposed as precedence characters to alter the interpretation of graphic characters assigned to columns 10 through 15 in the same manner that SO and SI can affect ASCII graphics in columns 3 through 7, or 03 through 07.

1. Proposed candidate standard functions required for display terminals used as "stand alone" or in conjunction with typewriter-like printers and keyboards. See Table 1.
2. Existing ASCII control functions as defined in ANSI Standard X3.4-1968 (ASCII) and ISO Recommendation R646.

The controls shall be used as specified in ANSI Standard X3.4-1968 (ASCII). See Table 2.

Figure 1.

Bits E_8 E_7 E_6 E_5	Column / Row	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
0 0 0 0	0	NUL	DLE	SP	0	@	P	`	p	CI	CD						
0 0 0 1	1	SOH	DC1	!	1	A	Q	a	q	PU	CIN						
0 0 1 0	2	STX	DC2	"	2	B	R	b	r	PD	CIF						
0 0 1 1	3	ETX	DC3	#	3	C	S	c	s	PR	SU						
0 1 0 0	4	EOT	DC4	$	4	D	T	d	t	PL	SD						
0 1 0 1	5	ENQ	NAK	%	5	E	U	e	u		NP						
0 1 1 0	6	ACK	SYN	&	6	F	V	f	v		PP						
0 1 1 1	7	BEL	ETB	'	7	G	W	g	w	PM	PFN						
1 0 0 0	8	BS	CAN	(	8	H	X	h	x	PH	PFF						
1 0 0 1	9	HT	EM	)	9	I	Y	i	y	PT							
1 0 1 0	10	LF	SUB	*	:	J	Z	j	z	CSC							
1 0 1 1	11	VT	ESC	+	;	K	[	k	{	CLC							
1 1 0 0	12	FF	FS	,	<	L	\	l	|	LI						
1 1 0 1	13	CR	GS	-	=	M	]	m	}	LD							
1 1 1 0	14	SO	RS	.	>	N	^	n	~	ESO							
1 1 1 1	15	SI	US	/	?	O	_	o	DEL	ESI							EO

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Proposed USA Standard, "General Purpose Alphanumeric Keyboard Arrangement for Information Interchange," *Communications of the ACM*, February 1968, pp. 126-131.

Characteristics of Alphanumeric and Vector Drawing Display Devices, Keydata Corporation, Watertown, Mass.

"Procedures for the Communication Control Characters of the ASCII in Specified Data Communication Links," X3.3.4/359, August 15, 1970.

American National Standard Vocabulary for Information Processing, ANSIX3.12-1970.

Note: ANSI Standards may be obtained

Table 1.

	Proposed Function	Proposed Abbreviation	Proposed Code Table Position or Sequence	
			7 Bits	8 Bits
1.	CURSOR (POINTER) UP	PU	ESC 4/1	08/1
2.	CURSOR (POINTER) DOWN	PD	ESC 4/2	08/2
3.	CURSOR (POINTER) RIGHT	PR	ESC 4/3	08/3
4.	CURSOR (POINTER) LEFT	PL	ESC 4/4	08/4
5.	CURSOR (POINTER) RETURN	PM	ESC 4/7	08/7
6.	CURSOR (POINTER) HOME	PH	ESC 4/8	08/8
7.	CURSOR TAB	PT	ESC 4/9	08/9
8.	CLEAR SCREEN FROM CURSOR	CSC	ESC 4/10	08/10
9.	CLEAR LINE FROM CURSOR	CLC	ESC 4/11	08/11
10.	LINE INSERT	LI	ESC 4/12	08/12
11.	LINE DELETE	LD	ESC 4/13	08/13
12.	CHARACTER INSERT	CI	ESC 4/0	08/0
13.	CHARACTER DELETE	CD	ESC 5/0	09/0
14.	CHARACTER INSERT ON	CIN	ESC 5/1	09/1
15.	CHARACTER INSERT OFF	CIF	ESC 5/2	09/2
16.	PROTECT FORMAT ON	PFN	ESC 5/7	09/7
17.	PROTECT FORMAT OFF	PFF	ESC 5/8	09/8
18.	SCROLL UP	SU	ESC 5/3	09/3
19.	SCROLL DOWN	SD	ESC 5/4	09/4
20.	NEXT PAGE	NP	ESC 5/5	09/5
21.	PREVIOUS PAGE	PP	ESC 5/6	09/6
22.	HORIZONTAL TAB SET	HTS	ESC 3/1	ESC 03/1
23.	HORIZONTAL TAB CLEAR	HTC	ESC 3/2	ESC 03/2
24.	HIGHLIGHT ON	HN	ESC 3/3	ESC 03/3
25.	HIGHLIGHT OFF	HF	ESC 3/4	ESC 03/4
26.	VERTICAL TAB SET	VTS	ESC 3/5	ESC 03/5
27.	VERTICAL TAB CLEAR	VTC	ESC 3/6	ESC 03/6
28.	REVERSE LINE FEED	RLF	ESC 3/7	ESC 03/7
29.	HALF LINE REVERSE FEED	HLR	ESC 3/8	ESC 03/8
30.	HALF LINE FORWARD FEED	HLF	ESC 3/9	ESC 03/9
31.	LOCAL COPY OFF (FULL DUPLEX)	LCF	ESC 3/10	ESC 03/10
32.	LOCAL COPY ON (HALF DUPLEX)	LCN	ESC 3/11	ESC 03/11

from American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10018.

Other X3 documents can be obtained from the X3 Secretariat: Business Equipment Manufacturers Association, 1828 L Street, N.W., Washington, D.C. 20036.

The *Federal Register* can be ordered from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

APPROVAL AUTHORITY FOR FIPS ASSIGNED TO OMB

Under the provisions of Public Law 89-306 (The Brooks Bill), recommendations for uniform Federal automatic data processing standards are made to the President by the Secretary of Commerce. The President recently delegated to the Director of the Office of Management and Budget authority to approve these standards on his behalf. The Presidential Memorandum reads as follows:

April 30, 1971

MEMORANDUM FOR THE DIRECTOR, OFFICE OF MANAGEMENT AND BUDGET

The Director of the Office of Management and Budget is hereby authorized and empowered to act finally, on behalf of the President, upon the recommendations provided for in Section 111(f)(2) of the Federal Property and Administrative Services Act of 1949, as amended (40 U.S.C.) 759(F)(2), concerning the establishment of automatic data processing standards for use by Federal agencies.

If, in any particular instance, the Director deems it appropriate to do so, he may submit such recommendations for my approval.

The Federal standards approved under this authority are intended to improve the Government's effectiveness in the use of automatic data processing systems. I expect that Federal agencies will apply these standards whenever their use will lead to greater operational efficiency and reduced costs.

This memorandum shall be published in the *Federal Register*.
RICHARD NIXON

This Memorandum was published in the *Federal Register* on May 12, 1971.

Table 2.

ASCII Control Function	ASCII Code Table Entry	Code Table Position or Sequence	
		7 Bits	8 Bits
NULL	NUL	0/0	00/0
START OF HEADING	SOH	0/1	00/1
START OF TEXT	STX	0/2	00/2
END OF TEXT	ETX	0/3	00/3
END OF TRANSMISSION	EOT	0/4	00/4
ENQUIRY	ENQ	0/5	00/5
ACKNOWLEDGE	ACK	0/6	00/6
BELL	BEL	0/7	00/7
BACKSPACE	BS	0/8	00/8
HORIZONTAL TAB	HT	0/9	00/9
LINE FEED (NEW LINE)	LF	0/10	00/10
VERTICAL TAB	VT	0/11	00/11
FORM FEED	FF	0/12	00/12
CARRIAGE RETURN	CR	0/13	00/13
SHIFT OUT	SO	0/14	00/14
SHIFT IN	SI	0/15	00/15
DATA LINK ESCAPE	DLE	1/0	01/0
DEVICE CONTROL 1	DC1	1/1	01/1
DEVICE CONTROL 2	DC2	1/2	01/2
DEVICE CONTROL 3	DC3	1/3	01/3
DEVICE CONTROL 4 (STOP)	DC4	1/4	01/4
NEGATIVE ACKNOWLEDGE	NAK	1/5	01/5
SYNCHRONOUS IDLE	SYN	1/6	01/6
END OF TRANSMISSION BLOCK	ETB	1/7	01/7
CANCEL	CAN	1/8	01/8
END OF MEDIUM	EM	1/9	01/9
SUBSTITUTE	SUB	1/10	01/10
ESCAPE	ESC	1/11	01/11
FILE SEPARATOR	FS	1/12	01/12
GROUP SEPARATOR	GS	1/13	01/13
RECORD SEPARATOR	RS	1/14	01/14
UNIT SEPARATOR	US	1/15	01/15
DELETE	DEL	7/15	07/15

SIX NEW FIPS APPROVED

The Office of Management and Budget, in a memorandum to the Secretary of Commerce, dated June 17, 1971, approved six new standards. These standards will be published by NBS in the Federal Information Processing Standards Publications (FIPS PUB) series. The six standards are:

FIPS PUB 13—Rectangular Holes in Twelve-Row Punched Cards (ANSI Standard X3.21-1967)

FIPS PUB 14—Hollerith Punched Card Code (ANSI Standard X3.26-1969)

FIPS PUB 15—Subsets of the Standard Code for Information Interchange

FIPS PUB 16—Bit Sequencing of the Code for Information Interchange in Serial-by-Bit Data Transmission (ANSI Standard X3.15-1966)

FIPS PUB 17—Character Structure and Character Parity for Serial-by-Bit Data Communication in the Code for Information Interchange (ANSI Standard X3.16-1966)

FIPS PUB 18—Character Structure and Character Parity Sense for Parallel-by-Bit Data Communication in the Code for Information Interchange (ANSI Standard X3.25-1968)

Information concerning the availability of these publications may be obtained from: National Bureau of Standards, Office of Information Processing Standards, Washington, D.C. 20234.

NSRDS NEWS

The NSRDS was established to make critically evaluated data in the physical sciences available to science and technology on a national basis. The NSRDS is administered and coordinated by the NBS Office of Standard Reference Data.

NEW PUBLICATION ARRANGEMENT FOR NSRDS

The major part of the output of the National Standard Reference Data System will be published in a new format beginning in 1972. Under an arrangement recently concluded with the American Institute of Physics (AIP) and the American Chemical Society (ACS), the two societies will jointly publish a *Journal of Physical and Chemical Reference Data* which will contain compilations of evaluated reference data and critical reviews prepared under the NSRDS program. Individual copies of data compilations appearing in the Journal will also be available for sale through AIP and ACS. Longer compilations which are unsuitable for a journal format will be published as special volumes associated with the Journal.

Initial plans call for four issues per year of the new Journal, with a total of about 1200 pages. Although designed primarily to serve as a publication outlet for the NBS-coordinated program, contributions of suitable quality from other sources will be considered. The Editorial Board of *J. Phys. Chem. Ref. Data* will have representation from NBS, AIP, and ACS.

The printing and distribution of the Journal will be handled by AIP, while ACS will have separate responsibility for marketing and promotion. Each society will offer the Journal at member rates to its own membership.

Certain NSRDS data compilations and reviews may still be published by the U.S. Government Printing Office and made available through the Superintendent of Documents. Previously published NSRDS compilations and reviews will continue to be sold by the Superintendent of Documents.

Information on subscriptions to the *Journal of Physical and Chemical Reference Data* and information on ordering reprints of individual compilations from the *Journal* will be announced in the NSRDS NEWS in a later issue.

TWO COMPILATIONS OF ATOMIC ULTRAVIOLET PHOTOABSORPTION CROSS SECTIONS

During the past several years the Joint Institute for Laboratory Astrophysics (JILA) Information Center at Boulder, Colorado, has been critically evaluating the reliability of cross section data for many atomic and molecular processes and producing comprehensive compilations of these data. Two compilations have recently been published which are the result of a joint effort between the JILA Information Center and the NASA Manned Spacecraft Center. The first is *Compilation of Ultraviolet Photoabsorption Cross Sections for Atoms Between 5 and 3500 Å* by Robert D. Hudson[1] (NASA SP-3064, $3) of the NASA Manned Spacecraft Center and Lee J. Kieffer of the National Bureau of Standards. This compilation is limited to experimental measurements only and includes data for all atomic species that have been measured within this wide energy range. The literature was searched for data through October 1969. The data selection was made on the basis of the inherent reliability of the measurement technique used in the determination. The data in the literature that have not been included were rejected for one of two reasons: either the data were not the result of an absolute measurement (or not normalized to an absolute value) or other results existed

that were obtained by more reliable methods. The text contains a discussion of experimental uncertainty, an explanation of the graphical display chosen, an indication of the organization of the compilation, and charts taken from the literature of the ultraviolet cross sections for atoms within the scope of the coverage. The last section contains an author index.

The second compilation, *Compilation of Atomic Ultraviolet Photoabsorption Cross Sections for Wavelengths Between 3000 and 10 Å*, was also authorized by Robert D. Hudson and Lee J. Kieffer. This compilation is also limited to experimental measurements and includes data for all atomic species that have been measured within this energy range. The literature was searched for data through October 1969. Graphical displays of selected experimental data on atomic photoabsorption cross sections as functions of wavelength are presented for 24 atoms. Criteria used in the data selection are discussed. References for all data chosen and an author index are included. This compilation was published in the journal *Atomic Data*, Vol. 2 for May 1971.

THERMOPHYSICAL PROPERTIES OF MATTER

For more than ten years, the Thermophysical Properties Research Center has been conducting integrated, continuing programs of literature search, bibliographic information organization and documentation, data compilation and critical evaluation, and theoretical and experimental research on thermophysical properties of matter. This Center, associated with the National Standard Reference Data System, has enlisted the cooperation of the worldwide scientific community and the collective support of many governmental and large private organizations. Under the general editorship of Y. S. Touloukian, Director of TPRC, and C. Y. Ho, a thirteen volume compilation entitled, *Thermophysical Properties of Matter* has been published by IFI/Plenum Data Corporation. Each volume in this series is accompanied by a registration card which entitles the user to receive, free of charge, an annual supplement containing any corrigenda and addenda that may eventuate during the lifespan of the edition. The volumes published thus far are given in Table 1. There is a special subscription price for the thirteen volumes at $595. Volumes may be ordered from IFI/Plenum Data Corporation, 227 West 17th Street, New York, N.Y. 10011.

SPECTROSCOPIC DATA RELATIVE TO DIATOMIC MOLECULES

The second edition of *Spectroscopic Data Relative to Diatomic Molecules*, prepared under the direction of B. Rosen, has been published by Pergamon Press as volume 17 of the *International Tables of Selected Constants*. This work is a revision of *Tables* published in 1951. The last twenty years have seen a large increase in the number of diatomic molecules for which spectroscopic data are available. Further, the extent and

Table 1.

THERMAL CONDUCTIVITY		
Volume 1	Metallic Elements and Alloys	$95.00
Volume 2	Nonmetallic Solids	85.00
Volume 3	Nonmetallic Liquids and Gases	55.00
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Volume 8	Nonmetallic Solids	$110.00
Volume 9	Coatings	100.00
THERMAL DIFFUSIVITY		
Volume 10		$50.00
VISCOSITY		
Volume 11		$50.00
THERMAL EXPANSION		
Volume 12	Metallic Elements and Alloys	$80.00
Volume 13	Nonmetallic Solids	80.00

precision of the data have greatly increased. Availability of new techniques and instrumentation have provided new data of major importance. Workers from many countries have colloborated to provide the Tables. It may be ordered from Pergamon Press sales offices in London, New York, Toronto, Australia and Braunschweig.

HANDBOOK OF HARDNESS DATA

Handbook of Hardness Data by A. A. Ivan'ko[1] (TT 70-50177, $3) is the latest in the series of Russian translations being published by the National Bureau of Standards and the National Science Foundation. The data in this reference book are classified into the three following groups according to the electron configuration of the valence electrons in the individual elements:

1) elements with atoms that have *s*-electrons and completely empty or completely filled inner electron shells (alkali metals, beryllium, magnesium, alkaline-earth metals, metals of the Cu and Zn subgroups);
2) elements with atoms that have partially filled *d*- and *f*-electron shells (transition metals);
3) elements with atoms that have valence *sp*-electrons (nonmetals and semimetals).

INFORMATOLOGIA YUGOSLAVICA

Informatologia Yugoslavica is a new periodical issued by the Center for the Study of Librarianship, Documentation and Information Sciences of the University of Zagreb, Yugoslavia. The first issue contains the following articles:

"Information, Documentation, and Communication (INDOC) System"
"Information Sciences and Services: Components, Relationships, and and Policies"
"The Role of Small Countries in International Information Systems with Special Respect to Yugoslavia"
"Some Problems of the First Croatian Printing—Works in Kosinj"
"Libraries in Croatia"
"Contribution to the Policy for Development of Information, Documentation and Communication (INDOC) Services in Croatia"
"Referral Center of the University of Zagreb"
"A Code of Good Practice for Scientific Publications"
"General Requirements for Technical Appearance of Doctoral Dissertations"

The periodical is printed in Croatian and English, with the English translation alongside the Croatian. The periodical is available on an exchange basis by writing Professor Bozo Tezak, Referral Center, University of Zagreb, 3 trg Marsala Tita, 4100 Zagreb, Yugoslavia.

[1] Order from National Technical Information Service, Springfield, Va. 22151 by number for priced indicated.

STANDARDS AND CALIBRATION

STANDARD FREQUENCY AND TIME BROADCASTS

High-frequency radio stations WWV (Fort Collins, Colo.) and WWVH (Kauai, Hawaii) broadcast time signals on the Coordinated Universal Time (UTC) system as coordinated by the Bureau International de l'Heure (BIH), Paris, France. The NBS time scale, UTC(NBS), and the U.S. Naval Observatory time scale, UTC(USNO), are jointly coordinated to within ±5 microseconds. The UTC pulses occur at intervals that are longer than one coordinated second by 300 parts in 10^{10} during 1971, due to an offset in carrier frequency coordinated by BIH. To maintain the UTC scales in close agreement with the astronomers' time, UT2, phase

adjustments are made at 0000 hours Greenwich Mean Time (GMT) on the first day of a month as announced by BIH. *There will be no adjustment made on October 1, 1971.*

The low-frequency radio station WWVB (Fort Collins, Colo.) broadcasts seconds pulses without offset to make available to users the standard of frequency so that absolute frequency comparisons may be made directly, following the Stepped Atomic Time (SAT) system. Step time adjustments of 200 ms are made at 0000 hours GMT on the first day of a month when necessary. BIH announces when such adjustments should be made in the scale to maintain the seconds pulses within about 100 ms of UT2. *There will be no adjustment made on October 1, 1971.*

NBS obtains daily UT2 information from forecasts of extrapolated UT2 clock readings provided by the U.S. Naval Observatory with whom NBS maintains close cooperation.

BROADCAST OF NEW TIME SCALE

Since 1967 the second has been defined in terms of an atomic transition, while time scales in general use are based on the rotation of the earth. This has resulted in the dissemination of a compromise time scale arrived at by international agreement through the International Radio Consultative Committee, and maintained by the International Bureau of Time (BIH). This scale, known as Coordinated Universal Time (UTC), presently operates with a frequency offset from the atomic scale of -300×10^{-10} to approximately agree with the rotation of the earth. Occasional step adjustments in time of 0.1 second are also made to compensate for unpredictable variations in the earth's rate of rotation.

To avoid the disadvantages of having an offset frequency and fractional second step adjustments, the UTC time scale will change on 1 January 1972. The new UTC scale will operate with a frequency offset, thus providing time intervals that are exactly one second long. The scale will continue to keep in approximate agreement with earth time, known as UT1, by step adjustments of exactly one second occurring about once per year. There will be a preference of adjustments on the 1st of January and July. In any case the new UTC scale should not differ from UT1 by more than 0.7 second.

In the U.S., therefore, the NBS standard broadcast services of WWV, WWVH, and WWVL will be changed to have zero offsets in their carrier and modulation frequencies and time signals. At 00 hours on 1 January 1972, UTC will be reset a fraction of a second, sufficient to give the new UTC scale an initial difference of an integral number of seconds (probably 10.000 seconds late) with respect to International Atomic Time (IAT) as maintained by the BIH. UTC is now about 9 seconds late compared to IAT, and during the next year the difference will probably increase to about 10 seconds; thus, the reset should be only a few hundred milliseconds. Thereafter, the difference between UTC and IAT will always be an integral number of seconds. The difference between UT1 (not UT2) and the broadcast signal will also be given after 1 January 1972, probably with a resolution of 0.1 second.

NEW TIME SIGNALS ON TELEPHONE

New time signals from the Bureau's radio station WWV can now be heard on the telephone. By dialing (303) 499-7111, listeners can hear the accurate shortwave signals from Fort Collins, Colorado, as received at the Bureau in Boulder, Colorado. These signals are a national service provided by the U.S. Department of Commerce.

The signals include a voice announcement of Greenwich Mean Time (GMT) every minute, plus standard audio-frequency tones and special announcements of interest to geophysicists and navigators. The time and frequency signals are the most accurate in the U.S. available to telephone users—callers from "the lower 48" should receive time signals accurate to within 30-40 milliseconds—and are controlled ultimately by the NBS Atomic Frequency Standard in Boulder.

Local time in the U.S. is derived from GMT by subtracting an appropriate number of hours. For instance, Mountain Daylight Time (MDT) is 6 hours earlier than GMT; 19 hours GMT is 13 hours MDT, or 1 p.m. The minutes and seconds are the same for GMT and local time. Thus, if you already know approximately what time it is, you only need to listen for the correct minute, and can omit calculating the hour. The time is given in the 24-hour system, where the hours from midnight to noon GMT are given the numbers 00 to 12, and from 1 p.m. to 11 p.m. GMT are given numbers from 13 to 23. Hence, 5:23 p.m. GMT would be given as 1723 GMT, or 17 hours, 23 minutes GMT.

In addition to the time and frequency signals, listeners may hear radio propagation forecasts for the North Atlantic region at 14 minutes past the hour, announcements of storm warnings for the North Atlantic Ocean at 16 minutes past (to be initiated sometime after July 1), and geophysical alerts and notices of significant solar events, such as flares, eruptions, and proton showers at 18 minutes past.

Further information on station WWV may be had by contacting Frequency-Time Broadcast Services Section, National Bureau of Standards, Boulder, Colorado 80302.

A METRIC AMERICA

A systematic, nationally coordinated U.S. changeover to the metric system of measurement over a 10-year period was recently recommended to Congress by Secretary of Commerce Maurice H. Stans in a 188-page report on the U.S. Metric study entitled "A Metric America—A Decision Whose Time Has Come."

The Study was conducted by the Department's National Bureau of Standards in accordance with the Metric Study Act of 1968. It involved three years of studies, surveys, and analyses by the Bureau with the cooperation of thousands of individuals and organized professional, educational, business, labor, and consumer groups throughout the country.

In releasing the Report, the Secretary said, "For many years, this nation has been 'going metric,' and it will continue to do so regardless of national plans and policies. At the same time, the worldwide use of the metric system is increasing, and today our's is the only major nation which has not decided to take such a step. As the Report

states, a metric America would seem to be desirable in terms of our stake in world trade, the development of international standards, relations with our neighbors and other countries, and national security."

Endorsing the Report's basic conclusion in favor of "going metric," Secretary Stans recommended:

- That the United States change to the International Metric System deliberately and carefully;
- That this be done through a coordinated national program;
- That the Congress assign the responsibility for guiding the change, and anticipating the kinds of special problems described in the report, to a central coordinating body responsive to all sectors of our society;
- That within this guiding framework, detailed plans and time-tables be worked out by these sectors themselves;
- That early priority be given to educating every American schoolchild and the public at large to think in metric terms;

– That immediate steps be taken by the Congress to foster U.S. participation in international standards activities;
– That in order to encourage efficiency and minimize the overall costs to society, the general rule should be that any changeover costs shall "lie where they fall";
– That the Congress, after deciding on a plan for the nation, establish a target date ten years ahead, by which time the U.S. will have become predominantly, though not exclusively, metric;
– That there be a firm government commitment to this goal.

As Dr. Lewis M. Branscomb, National Bureau of Standards director, puts it, the Report is concerned with alternatives "realistically open to the United States. . . ."

- Changing to the metric system by plan, or
- Drifting to metric without a plan.

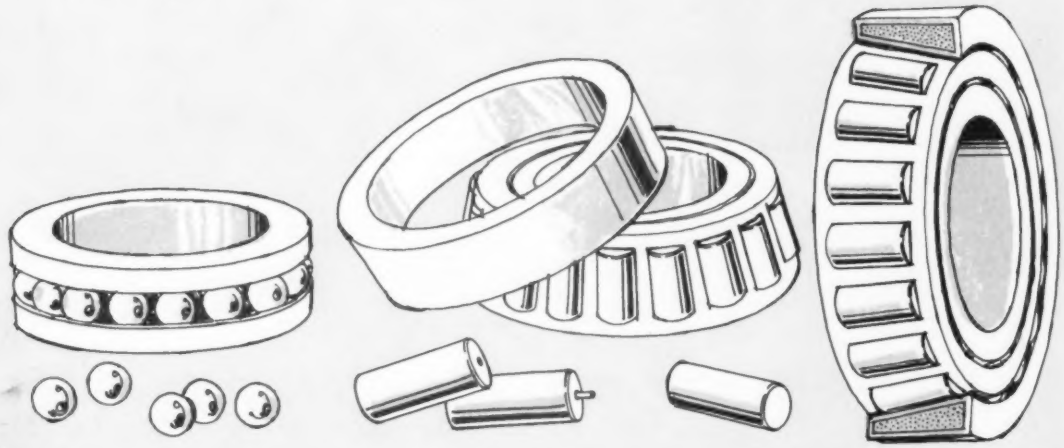
Dr. Daniel V. DeSimone, Metric Study Director and author of the Report, observes in the Preface that current circumstances–unlike those prevailing when Thomas Jefferson and John Quincy Adams first considered the metric system's attributes–have made the time for a U.S. decision ripe because "the world has committed itself to the metric system, and even in the United States its use is increasing. For America, it is a decision whose time has come."

"In even a concerted program for going metric," the report points out in Chapter V "some things would be changed rapidly, some slowly, and some never. In most cases, things would be replaced with new metric models only when they wore out or became obsolete. This would certainly be true, for example, of existing buildings, aircraft carriers, railroad locomotives, power generating plants, and even such things as hair dryers.

"In many instances industry and commerce would make metric changeovers much as the housewife did when she broke her non-metric measuring cup. A pump in a chemical factory, for example, might with careful maintenance last ten years before it wore out and had to be replaced. But if a critical part failed after, say, five years, the user might well decide to buy a new pump of improved design and lower running cost, rather than fix the old one. And if he were going metric and metric pumps were available, the new pump would, of course, be one built to metric standards."

The proposed 10-year "optimum" period for a coordinated national

A METRIC CONVERSION CASE STUDY



Anti-Friction Bearings

Metric units usually prevail in technologies that first developed on the European continent. Customary units have the upper hand in technologies first developed in the U.S. and Great Britain. The anti-friction bearing industry represents a mixture of both.

Ball bearings and parallel roller bearings, originating in Europe, are designed to metric standard sizes. These sizes are also used in the U.S., although they may be described in terms of inches.

Tapered roller bearings, on the other hand, originated in the U.S. and were therefore designed to Customary standard sizes. Now, many U.S. manufacturers are beginning to design their new tapered roller bearings to metric standard sizes. These firms are concerned about expanding their overseas operations and increasing their exports to an otherwise metric world.

The companies involved in this changeover say that it has been on the whole rewarding. They have been able to produce complete lines of tapered roller bearings with a reduction of superfluous types, and they have improved their competitive positions in the world market. They report no noteworthy disadvantages. Here is how they regard the changeover:

- No substantial costs can be attributed directly to going metric. With different parts of the world using different measurement systems, they have to pay the costs of labeling drawings in both Customary and metric units, but this was a cost they paid before anyway.
- Since the conversion involves design alone, only the engineering staff has had to be retrained. At one of the largest companies the engineers learned what they needed to know informally.
- It has not been necessary to replace or even greatly modify a single piece of Customary manufacturing machinery to produce to metric standard sizes. With dual labeling and conversion charts, any worker in any plant has been able to produce any bearing on any suitable piece of equipment.
- While going metric, one manufacturer has developed a new line of tapered roller bearings that incorporates the best features of both Customary and metric technologies. The company hopes that this line will win acceptance in the U.S. and ultimately throughout the world.
- Until this new line is widely accepted, there is no need for the industry to coordinate its efforts or set a conversion timetable for the entire field of tapered roller bearings. In the meantime, each company is applying metric to new designs only.
- Some customers still need bearings in Customary sizes, and these are being supplied. By and large, however, U.S. industry has readily accepted the new metric designs.

changeover is based upon information and views contributed by many cross-sections of society, ranging from whole industries to individual citizens contacted by mail or telephone or at public hearings. Opinions and data were collected from large and small firms, labor unions, professional and technical societies, and specialized groups. In Chapter VII the Report calls it "perhaps surprising that any general pattern of agreement should have emerged from the U.S. Metric Study, considering the great diversity of the participants." At any rate, these representative feelings emerged:

"Some participants in the study preferred that the change be made more quickly; a few wanted more time. Nevertheless, all could be accommodated by a ten-year transition period, because those who could move faster would do so as soon as their customers and suppliers were ready. Those who needed more time could take it, since the nation's goal in a ten-year program would be to become mostly (not entirely) metric.

"Most manufacturing firms judged that the ten-year period would be close to optimum for them. Weighting manufacturers according to size (i.e., value added in manufacturing), the Study found that 82 percent thought the changeover period should be ten years or less. The average of the periods chosen was 9.6 years.

"In its study the Department of Defense concluded: 'DoD is dependent upon the National Industrial Base, and the rate of conversion within the DoD will be dependent on how well conversion is carried out by industry.'

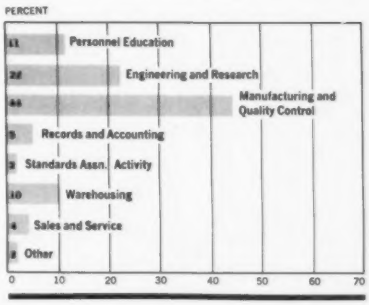
"Nonmanufacturing businesses, with generally much less hardware needing conversion, were in favor of a shorter transition period. They thought that the nation as a whole might make the changeover in six to ten years.

"In the commercial weights and measures field, the adaptation to metric of devices now in use would take considerable time. The survey of this field points out that there are relatively few trained personnel who can do the work. Because of the large numbers and varieties of devices now in use, ten years would be required to complete adaptations."

Advocating a phase changeover guided by "the rule of reason,"* the report holds that expectations of a "painless and casual drift" toward a comprehensive changeover would be just as unrealistic as an attempted "abrupt and mandatory" transformation that would prove to be intolerably disruptive.

"Our experience since Congress legalized the metric system in 1866 suggests that if the nation prefers to drift to metric, it would still be having to cope with two measurement systems at the end of this century," the Report observes. "Since the use of the metric system in the U.S. is increasing, throughout the prolonged period of gradual change there would be substantial costs and inconveniences, primarily those associated with maintaining dual inventories, training people in both measurement systems, and printing metric and Customary dimensions on documents and labels."

Manufacturing Industry Survey: Allocation of Estimated Costs of Going Metric



The complex question of the relative benefits and costs that would be involved in a planned 10-year metric changeover is discussed in Chapter IX of the Report, with accompanying diagrammatic representations of projections and analyses. Investigators for the Metric Study found that a simple aggregate profit-and-loss figure for the total effect of the proposed metric changeover could not be arrived at, for a variety of reasons: benefits and costs would occur at different times and would not be directly comparable; virtually all costs would be incurred during the transition period, when benefits would be only beginning; there would be many intangibles to consider, and some phenomena might be attributable only partly to a metric change. The Report in Chapter IX points out that the real question is not what the cost of a metric changeover would be but whether it would cost more to change by plan or without one. The report con-

**The Rule of Reason*

Some measurements and some dimensions would never need to be changed. It would be preposterous ever to tear up all our railroad tracks just to relate them to some round-number metric gauge. Americans would not be likely to translate into metric such sayings as "a miss is as good as a mile," or to rewrite the words to the song **I Love You a Bushel and a Peck.**

In sports, going metric is not likely to present much of a problem. Soccer is internationally the most popular game by a wide margin, and fortunately there is no standard size for a soccer field. Cricket is played throughout the old British Empire, but although most of the nations that play it have either gone metric or are doing so, they will presumably cling to the traditional Imperial dimensions of the cricket pitch. Similarly, it would be quite unnecessary to change the length of U.S. football fields, even if our kind of football ever became an international sport. And keeping them as they are, no sports announcer who wants to keep his audience would ever seriously say: "The Redskins have the ball; first down and 9.144 meters to go."

Some units that are not part of the International Metric System may continue to be used wherever they are believed to make communications and calculations clear and easy. Even in metric countries meteroroigists still speak of "bars," one bar being roughly normal atmospheric pressure, and of the "millibar," which is one-thousandth of a bar. Astronomers prefer to talk of distance in "light years," instead of many trillions of kilometers. Such convenient units as these are not likely to be discarded.

Even if it were to be specified that only International Metric units were to have full legal standing, many other measurement terms would persist in our culture – perhaps forever.

**Order starred items prepaid from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 by SD Catalog number. Items not starred are in press and will be available in the near future.

cluded that it would be better to change by plan. "The cost and inconvenience of a change to metric will be substantial, even if it is done carefully by plan. But the analysis of benefits and costs made in this chapter confirms the intuitive judgment of U.S. business and industry that increasing the use of the metric system is in the best interests of the country and that this should be done through a coordinated national program. There will be less cost and more reward than if the change is unplanned and occurs over a much longer period of time."

Under the heading of intangible and indirect benefits, the Report cites a variety of potential "by-products" of conversion: "People, while making the metric change, would have opportunities to do other worthwhile things that are not directly related to any measurement system. Translating textbooks into metric terms would provide opportunities for curriculum improvements. In thinking out new metric standards, engineers would have an opportunity to weed out superfluous sizes and varieties of parts and materials, and even to incorporate superior technologies. International standards activities would be facilitated."

Other chapters in the Report review the two centuries of debate over the U.S. measurement system, compare the metric and Customary systems and the arguments for and against each, place the metric question "in the context of the future world," discuss problems needing early attention, and compare the differing experiences of Great Britain and Japan in going metric. Appendices to the Report detail how the U.S. Metric Study was planned and carried out, present a selective bibliography of Metric Study documents and official reports of the U.S. and foreign countries, and give the text of an International Organization for Standardization recommendation on the uses and applications of units of the International System.

A Metric America is available from the Superintendent of Documents, U.S. Government Printing Office, for $2.25; use SD Catalog No. C13.10:345 when ordering.

The information upon which *A Metric America* is based is contained in a series of 12 supplemental reports, authored by members of the Metric Study Group:

**THE MANUFACTURING INDUSTRY, An Interim Report of the U.S. Metric Study, by Morris H. Hansen (Westat Research, Inc.), A. G. McNish and Louis E. Barbrow, NBS Spec. Publ. 345-4, issued July 1971, $1.25, SD Catalog No. C13.10:345-4.

NONMANUFACTURING BUSINESSES, An Interim Report of the U.S. Metric Study by Elaine D. Bunten and June R. Cornog, NBS Spec. Publ. 345-5, issued July 1971, 200 pages; $1.50; SD Catalog No. C13.10: 345-5.

EDUCATION, An Interim Report of the U.S. Metric Study, by Berol L. Robinson (Education Development Center), NBS Spec. Publ. 345-6, issued July 1971, 216 pages; $1.75; SD Catalog No. C13.10:345-6.

THE CONSUMER, An Interim Report of the U.S. Metric Study, Bruce D. Rothrock, editor, NBS Spec. Publ. 345-7, issued July 1971, 152 pages; $1.25; SD Catalog No. C13.10:345-7.

INTERNATIONAL TRADE, An Interim Report of the U.S. Metric Study, by Gerald F. Gordon (Bureau of Domestic Commerce), NBS Spec. Publ. 345-8, issued July 1971, 188 pages; $1.50; SD Catalog No. C13.10: 345-8.

**ENGINEERING STANDARDS, An Interim Report of the U.S. Metric Study, by Robert D. Stiehler, NBS Spec. Publ. 345-11, issued July 1971, 260 pages; $2.00; SD Catalog No. C13.10: 345-11.

**INTERNATIONAL STANDARDS, An Interim Report of the U.S. Metric Study, by Robert D. Huntoon et al, NBS Spec. Publ. 345-1, issued December 1970, 157 pages; $1.25, SD Catalog No. C13.10:345-1.

**DEPARTMENT OF DEFENSE, An Interim Report of the U.S. Metric Study, by Leighton Lomas et al (Dept. of Defense), NBS Spec. Publ. 345-9, issued July 1971, 128 pages; $1.25; SD Catalog No. C13.10:345-9.

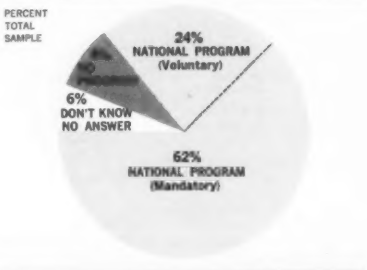
**FEDERAL GOVERNMENT: CIVILIAN AGENCIES, An Interim Report of the U.S. Metric Study, by Roy E. Clark and John M. Tascher, NBS Spec. Publ. 345-2, issued July 1971, 324 pages; $2.25; SD Catalog No. C13.10:345-2.

**COMMERCIAL WEIGHTS AND MEASURES, An Interim Report of the U.S. Metric Study, by Stephen L. Hatos, NBS Spec. Publ. 345-3, issued July 1971, 110 pages; $1; SD Catalog No. C13.10:345-3.

A HISTORY OF THE METRIC CONTROVERSY IN THE UNITED STATES, An Interim Report of the U.S. Metric Study, by Charles F. Treat, NBS Spec. Publ. 345-10, due July 1971.

TESTIMONY OF NATIONALLY REPRESENTA-

Non-Manufacturing Businesses: If Increased Metric Usage Is in "Best Interest of the United States," What Course of Action?



TIVE GROUPS. An Interim Report of the U.S. Metric Study, by Jeffrey V. Odom, Editor, NBS Spec. Publ. 345-12, issued July 1971, 180 pages; $1.50; SD Catalog No. C13.10:345-12.

THE MANUFACTURING INDUSTRY

The important findings of the substudy, based on inputs supplied by over 2000 firms, are that about 10 percent of U.S. manufacturing companies make some use of metric measurements and that such use is increasing; that although attitudes are mixed as to whether increased use of the metric system in their own industry would be beneficial, the companies preponderantly (70 percent) feel that increase metric use would be in the best interest of the United States; and finally, under the assumption that increased metric usage is found to be officially encouraged in the U.S., 93 percent of the companies favored a planned program of metrication (50 percent a voluntary plan, 43 percent a mandatory plan) and only 7 percent favored an uncoordinated approach.

NONMANUFACTURING BUSINESSES

Information for this survey was obtained from extended telephone interviews with key persons (who had been notified in advance) in about 2600 business firms and nonprofit organizations. The report sums up the essence of its findings in 18 points a few of which (abbreviated or paraphrased) follow:

**About 86 percent of the total sample favor a planned national program of conversion if metrication is found to be in the best interests of the U.S.

**About 62 percent of the total sample favored a national program of conversion based on legislation.

**Large corporations tended to be more favorable to such a metrication policy, but more than 80 percent of each size class favored a planned program.

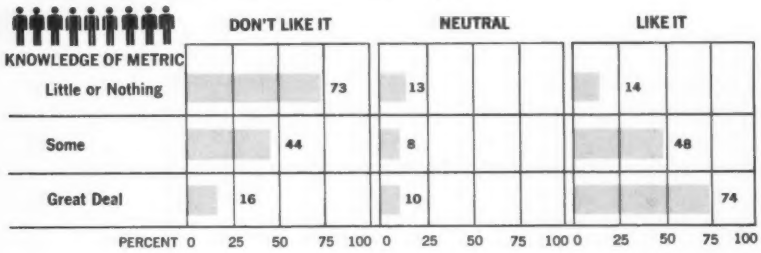
**The retraining of labor was seen as the chief obstacle to conversion.

**Respondents with personal knowledge of metric measurement anticipated fewer problems and lower costs in retraining company employees than did respondents with little or no knowledge of metric.

**Six percent declared their intention to begin using or to increase their use of metric measurements within the next year or so; the stated reasons were chiefly to "improve the quality" of their output, ease international commerce, or meet foreign competition.

**Servicing of foreign produced metric items is the worst problem associated with their purchase; the same difficulty, said the distributive industries, affects U.S. non-metric goods in foreign markets.

The More People Know About Metric The More They Like It



EDUCATION

Major conclusions of the report are: If the U.S. "goes metric" our chief educational needs will be for new instructional materials, some retraining of teachers already serving, and replacement and modification of some instructional material. A minimum time scale is dictated by textbook replacement patterns: most school districts replace textbooks about every 5 years; and publishers need about 3 years lead time for preparing new materials. A 10-year conversion period, with a national coordinating body to guide publishers and school boards, should enable us to replace most textbooks (and library books and encyclopedias) at essentially no added cost over normal operations either to school districts or to textbook publishers.

THE CONSUMER

The U.S. Metric Study determined the attitudes of Americans toward the metric system and their knowledge of it through a survey of a representative sample of American households carried out by the Survey Research Center of the University of Michigan; the report of this survey makes up the first part of this interim report. The consumer survey report is supplemented by papers on selected areas of consumer interest prepared by various individuals and organizations.

The survey disclosed that a majority of consumers know very little about the metric system (only 40 percent of the individuals surveyed could name even one metric unit), but that the more they know about the metric system the more they favored it. The experts submitting papers agree that successful conversion to the metric system would require a comprehensive program of public education. Consumers in general believe that after the change-over is completed, the advantages will outweigh the costs and inconveniences of the transition. Metrication is also visualized as an opportunity, perhaps an incentive, to introduce improved standards for clothing sizes, simplification of package and can sizes, elimination of confusing practices in consumer products information, and possible standardization at the international level.

INTERNATIONAL TRADE

This report presents data for an evaluation of the potential effects that a U.S. conversion to the metric system may have on the nation's foreign trade, based on a survey of exporters and importers of products in which dimensions are critical, products that include tractors, clinical thermometers, vacuum pumps, typewriters, and computers. The firms surveyed were asked to rank the factors that influence sale or purchase of these products in international trade. They were also asked to estimate how much they would expect to export or import in 1975 if the U.S. had gone metric in 1970. The results are summarized and tabulated in this volume, prepared by the Bureau of Domestic Commerce of the Department of Commerce. One interesting statistic is that exports in 1975 would be increased by about $600 million if the country had converted in 1970.

The report falls into four parts which, in turn: summarize the Study's findings in 25 short paragraphs; briefly describe the role of the U.S. in world trade and discuss current problems connected with our Balance of Payments and the need to generate a larger trade surplus; evaluate the potential impact of metrication on U.S. foreign trade, analyzing the results of the Bureau of Domestic Commerce survey of U.S. exports and importers; and analyze the potential impact of metrication on selected industries. There is one appendix on the objectives and methodology of the study and another consisting of relevant statistical tables.

ENGINEERING STANDARDS

This report is based on a survey of the four categories of international engineering standards: dimensional, quality, descriptive, and methods of test. One interesting finding in the survey is that incompatibility between international standards and our national standards exists to about the same extent in quality and descriptive standards as in dimension standards; this suggests that it is engineering practice, in the development of which measurement units play an important role, rather than the measurement units themselves that determines compatibility or incompatibility of most standards. This finding points up the need for active U.S. participation in the drafting of international recommendations so

that they reflect U.S. practice. In those cases in which compatibility involves metrication and therefore a change in U.S. engineering standards, advantage should be taken of the opportunity to redesign the products involved so as to conserve raw materials, improve quality, and reduce costs.

The report states that although it is still possible to retain and promote U.S. standards without a change in our measurement units, it is becoming more and more difficult to do so; promotion of U.S. standards internationally is facilitated when the standards permit easy use in metric countries, a fact whose recognition is reflected in increasing use of metric measurement units in U.S. standards.

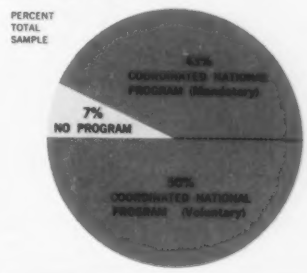
INTERNATIONAL STANDARDS

In his letter of transmittal, NBS Director L. M. Branscomb notes that this interim report was prepared "as an offshoot of our inquiry into the issues of metrication." It deals with the probable effects on international trade not only of increased use of the metric system but, even more importantly, of greater U.S. participation in international standardization activities, especially in the development of product performance standards. It argues that suitable policies in these areas can lead to a very considerable improvement in the U.S. trade position. Without spelling out details of implementation, it urges greater attention to the possibility of Federal leadership in encouraging greater support by U.S. industry for international standardization, the desirability of substantial Federal assistance to our private sector standardizing institutions, and other alternatives that might emerge from a thorough review of this question with such institutions and other interested parties. In transmitting the report to Congress, Secretary of Commerce Maurice H. Stans concurred with its conclusions and invited the consideration and views of the Congress and the public. Over half of the publication consists of appendixes, including further discussion of international standards, the general plan for the Metric Study, and a large sampling of the many different questionnaires employed in obtaining information for the Metric Study as a whole. (Further details on this publication are given in the NBS Technical News Bulletin for March 1971, pages 69-70.)

DEPARTMENT OF DEFENSE

This report gives an evaluation of the impact of converting to the metric system of measurement on the operational capability of the Department of Defense and summarizes the advantages and disadvantages incident to such conversion. The DoD recognizes that any decision to go metric is a national one and does not take a position either for or against conversion. The rate of conversion within DoD would depend upon the rate of conversion in industry. The advantages expected of metrication are long-range in nature; they include the day-to-day use of an inherently simpler system and the compatibility of U.S. and foreign equipment, both of which would enhance combined military operations and simplify logistic support requirements. The disadvantages of metrication, including a substantial cost, are almost entirely short-range in nature and would be encountered almost entirely during the transition period: they include psychological resistance to change, the need for extensive retraining of personnel, increase of operational hazards, the creation of "mixed" (dual-measurement) systems, and the maintenance of dual inventories. If conversion becomes national policy, the DoD calls attention to

Manufacturing Businesses:
If Increased Metric Usage is in "Best Interests of United States," What Course of Action?



the need for a national schedule for metrication.

FEDERAL GOVERNMENT: CIVILIAN AGENCIES

All agencies of the Federal Government that could be significantly affected by a metric changeover participated in the U.S. Metric Study. This report brings together and records the views of 55 civilian agencies (except the Department of Defense, which is covered in NBS SP345-9) on the basic questions raised by the Metric Study Act. The report gives the agencies' evaluation of the impact of a metric shift on the internal operations of the agencies and on national activities (transportation, communication, etc.) over which the agencies have responsibility, and also on the ability of these agencies to perform their missions with respect to these "areas of national responsibility." Based on "best guess" estimates, the survey found that costs would be much less than one percent of the total annual budget of the agencies reporting. The survey found widespread feeling that a coordinated national effort to increase the use of SI measurement units and engineering standards in the U.S. is desirable, and also substantial expectation of increasing problems in the Federal Establishment if the current drift towards metric continues. The Small Business Administration is

especially concerned that small businesses are being left behind.

COMMERCIAL WEIGHTS AND MEASURES

The purposes of this interim report are to identify and describe the impacts (cost, time, etc.) of changing selected commercial weighing and measuring devices to record and/or indicate in metric units and analyze the problems that increased metric usage would impose on state and local weights and measures jurisdictions (e.g., laws and regulations, testing equipment, and training programs). Included here are the presentations of views of scale manufacturers, and of weights and measures engineers and inspectors, the report of the National Conference on Weights and Measures' Task Force on Metrication, summaries of relevant statistics, and texts of present legislation dealing with weights and measures, including packaging and labeling. In the event that the U.S. decides to convert to the metric system for commercial weights and measures, recommendations are made concerning cut-off dates for use of customary units and the nature of the changes required in the text of the laws. During a transition period labels would be required to give both metric and customary units, inclusion of the customary units on labels becoming optional after a certain period.

A HISTORY OF THE METRIC SYSTEM CONTROVERSY IN THE UNITED STATES

This segment of the U.S. Metric Study has two objectives: to document earlier actions affecting weights and measures used by the United States and to chronicle previous investigations into the feasibility and desirability of increasing U.S. use of the metric system of weights and measures. Creation of the metric system in France and the beginning of serious deliberations in the United States with regard to fixing a standard of weights and measures occurred in the same year—1790. Since then, the question of whether the U.S. should accede to the worldwide trend toward use of the metric system or give legal sanctity to our customary system of English origin has been debated on many occasions but has never been answered decisively. In the process, however, many alternative actions were proposed and deliberated upon, a few decisions having permanent significance were made, and on several occasions sharply contested controversies lent the subject of weights and measures a quite unaccustomed glamor.

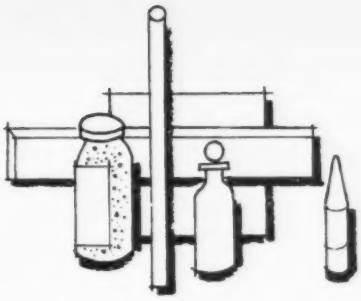
Particular attention is paid here to the many activities of the legislative branch (about 100 legislative proposals, a dozen congressional committee hearings, two dozen committee reports, among other sources) relevant to this subject and to various campaigns that from time to time were waged either for or against adoption of the system. The main contentions advanced by both sides to the debate are presented. Throughout, the issue is treated as a social, political, and economic problem rather than as a scientific or technological one, and special pains are taken to show the relationship of other contemporary issues to the question of whether or not the U.S. should increase its use of the metric system.

TESTIMONY OF NATIONALLY REPRESENTATIVE GROUPS

To provide an opportunity for widespread participation in the U.S. Metric Study, over 700 major national groups (trade associations, labor unions, professional societies, and others) were invited to submit their opinions and cost-benefit estimates concerning a possible future conversion to the metric system, to supplement the information collected by special surveys and investigations. Many groups responded, representing 674,000 firms and 19,600,000 individuals. Their testimony is summarized in the present report, along with supplementary inputs from experts in consumer activities and education.

The following suggests a few highlights of the testimony. Advantages of the metric system most often cited include that it is easy to learn, remember, and understand; that a changeover would provide the opportunity for design improvement and elimination of needless sizes and types of products; that it would lead to wider markets for exports products, world-wide interchangeability, and a wider choice range among imports. Transition problems appear significant mainly: where metrication requires extensive modification of manufacturing equipment; where additional stocks of materials and spare parts would be needed; and in consumer education. About 50% of the groups stated that change to the metric system is inevitable and/or desirable, about 45% indicated it would not matter to their activities whether we change our measurement system or not; and 5% felt that it was not inevitable and oppose a change.

STANDARD REFERENCE MATERIALS



Standard Reference Materials are well-characterized materials certified for chemical composition or for a particular physical or chemical property. These materials are disseminated by NBS to be used to calibrate and evaluate measuring instruments, methods, and systems or to produce scientific data that can be referred readily to a common base.[1]

ORCHARD LEAVES

The Office of Standard Reference Materials announces the availability of 5 new and 7 renewal SRM's including the first of a series of botanical standard reference materials analyzed for chemical elements. This material, identified as SRM 1571, Orchard Leaves ($68 for a 75-gram sample), is being issued on a provisional certificate. SRM 1571 is intended for use in the calibration of apparatus and methods used in analyses of agricultural and other botanical materials for major, minor, and trace elements.

The need for such standard materials was called to NBS attention by Professor A. L. Kenworthy of Michigan State University and was supported by the American Society of Horticultural Scientists, the American Society of Agronomy, and the U.S. Atomic Energy Commission, in addition to a number of researchers in the field of trace element analysis in biological materials. A great deal of work has been done in this area in recent years to determine where trace elements are essential and where they are merely casual inclusions resulting from the environment. The SRM will be used for leaf analysis to ascertain the type and amount of crop fertilization necessary, and in the analysis of particulate samples and vegetation samples in pollution studies.

The leaves were collected from an orchard near Lansing, Michigan, and are primarily peach tree leaves with some from apple and cherry trees. The collected leaves were air dried, comminuted to 40 to 60 mesh, and dried again at 185 °F. This work was performed at Michigan State University under the direction of Professor Kenworthy.

To guard against the possibility of bacterial growth or mold, the comminuted leaves were sealed in polyethylene bags and sterilized by means of gamma radiation. This work was carried out at the U.S. Army Natick Laboratories.

SRM 1571 is certified for calcium, potassium, iron, sodium, copper, and nickel. The content of the following elements is given for information only: mercury, lead, nitrogen, magnesium, phosphorus, arsenic, bismuth, boron, chromium, cobalt, fluorine, manganese, selenium, uranium, and zinc. These analyses were made using the techniques of: atomic absorption spectrometry, flame emission spectrometry, gravimetric phosphorus, Intersociety Committee Method for fluorine, isotope dilution-spark source mass spectrometry, Kjeldahl nitrogen, neutron activation, nuclear track technique, and polarography. The evaluation of the homogeneity of the sample was based on the magnesium, nitrogen, and potassium analyses using a minimum sample size of 250 milligrams. The average content for the entire lot has been determined to be approximately ±1 percent or better

for the major elements and to approximately ±3 percent for the minor elements (95 percent confidence).

Five other botanical materials—alfalfa, citrus leaves, pine needles, tomato leaves, and aspen wood chip—will be issued as SRM's subject to demonstration of acceptable homogeneity.

RUBIDIUM CHLORIDE

SRM 984, Rubidium Chloride (RbCl weight percent is 99.90 ± 0.02, absolute abundance ratio, $^{85}Rb/^{87}Rb$, is 2.593 ± 0.002, $43 per 1-g sample) was prepared to ensure material of intermediate purity and high homogeneity. The material is somewhat hygroscopic, absorbing approximately 0.6 percent moisture in a 75 percent relative humidity at room temperature, but can be dried to the original weight by desiccation over freshly exposed P_2O_5 or $Mg(ClO_4)_2$ for twenty-four hours. The material should therefore be stored with a desiccant such as P_2O_5.

The assay of this material is based on the determination of rubidium by a combination of gravimetry and isotope dilution analysis. All weighings were corrected to vacuum and the atomic weights used in the calculations were from the 1969 Table of Atomic Weights. The indicated uncertainty includes both the analytical error and estimated possible systematic errors.

THERMAL ANALYSIS SRM'S

SRM's 755 and 756, quartz and potassium nitrate, have been issued for use in thermal analyses. The quartz (SRM 755) is furnished in 2-gram units sized from 100 to 325 mesh; the potassium nitrate is furnished in 5-gram units of fine crystals. Each unit is priced at $35. These compounds are the first two materials made available from a group of compounds screened by the Standards Committee of the International Conference on Thermal Analysis. It is anticipated that with additional cooperation with the newly formed ASTM provisional committee on thermal analysis, further progress will be made in screening and supplying materials suitable for differential thermal analysis and differential scanning calorimetry standards covering subambient to very high operating temperatures.

Quartz has a phase transition at approximately 575 °C, and potassium nitrate at approximately 130 °C. The transition temperatures given on the certificates are the means of the values obtained on several differential thermal analysis instruments.

ALUMINA

SRM 742, aluminum oxide, is a pyrometric standard for realizing the alumina melting point (2053 °C) on the International Practical Temperature Scale (1968). The material furnished is a calcined alpha alumina of 99.9+ percent purity and costs $62.50 for a 10-g sample. The melting point given is the value obtained when the material is melted in a vacuum using tungsten containers, and does not necessarily represent the melting point of pure alpha alumina. It is estimated from an examination of twenty subsamples that the melting point of this sample does not deviate by more than 2 °C from 2053 °C, and that melting point determinations, including temperature measurements, were reproducible within ±1 °C. The overall maximum uncertainty of the melting point is estimated to be ±5 °C.

Renewal Standards

PLUTONIUM

SRM 949c, plutonium metal ($123 for a 0.5-g sample) provides material for the chemical assay of plutonium. Each sample consists of several pieces of metal sealed in a glass tube under a reduced-pressure argon atmosphere. The sample number and the weight of the sample are given on each tube.

The americium resulting from the decay of 14-year plutonium-241 is approximately 70 ppm at the date of issue, and will increase less than 50 ppm per year. The total of other detected impurities is about 50 ppm. Impurity determinations indicate that the material is quite homogeneous, that the metal should approximate 99.99 percent purity and that the plutonium assay value and limits largely reflect the difficulties associated with the assay of small amounts of plutonium. These samples were prepared and analyzed by the Los Alamos Scientific Laboratory of the University of California, Los Alamos, New Mexico, in collaboration with the National Bureau of Standards.

IRON AND MAGNESIUM SRM'S FOR PETROLEUM

SRM 1079b, tris(1-phenyl-1,3-butanediono)Iron(III) (10.45 ± 0.04 percent iron) was prepared to ensure material that is essentially free from other metals and has suitable solubility, compatibility, and uniformity for use in the preparation of a standard of iron in lubricating oils. The compound, certified to one part per hundred of iron, is priced at $31 for a 5-g sample.

The uncertainty shown represents the 95 percent confidence limit of the mean based on 16 determinations made by two methods and on allowances for the effects of known sources of possible errors. In one method a 0.5-g sample was wet-ashed with nitric and sulfuric acids and precipitated with ammonium hydroxide. The precipitate was dissolved in

hydrochloric acid and the iron reduced with stannous chloride. It was then titrated with potassium dichromate solution. Other samples were nondestructively analyzed using the 14 MeV neutron activation technique.

The compound was also examined spectrographically for metallic impurities. A 5-mg sample of the compound was excited in a direct-current arc and the photographed spectrum was examined for the characteristic lines of 51 elements. Several impurities were found, but none is considered to be present in sufficient concentration to interfere with the intended use. Tests show that standard lubricating-oil solutions of this compound with concentrations of iron up to 500 ppm are stable for several weeks.

SRM 1061c, magnesium cyclohexanebutyrate, 6.45 ± 2 percent (magnesium) is a standard for determination of magnesium in petroleum products and costs $31 for a 5-g sample. The uncertainty shown represents the 95 percent confidence limit of the mean based on twelve determinations and allowances for the effects of known sources of possible errors.

Magnesium was determined by wet-ashing a 1-g sample (dried for 48 hr over phosphorus pentoxide) with sulfuric and nitric acids, precipitating twice with diammonium hydrogen phosphate, and weighing the $Mg_2P_2O_7$ after ignition at 1050 °C. The compound was also examined spectrographically for metallic impurities. A 5-mg sample of the compound was excited in a direct-current arc and the photographed spectrum was examined for the characteristic lines of 51 elements. No significant impurities were found. Tests show that standard lubricating-oil solutions of this compound with concentrations of magnesium up to 500 ppm are stable for several weeks. The magnesium cyclohexanebutyrate was prepared by the Eastman Kodak Company of Rochester, N.Y.

POTASSIUM DICHROMATE

SRM 136c, potassium dichromate (oxidimetric standard, purity on basis of effective oxidizing power is 99.98 ± 0.02 percent), conforms to the American Chemical Society specification for analytical reagent grade material, but is not to be considered as entirely free from traces of impurities. It is priced at $26 for a 60-g sample. The SRM is certified only for its effective oxidizing power. Standardizations have been made by the coulometric method by direct comparison with arsenic trioxide SRM 83c, and by comparison with the previous SRM 136b through ferrous ammonium sulfate.

Drying tests on the SRM indicate that losses of approximately 0.005 percent are obtained on a few hours drying at 105 °C; long time drying indicates that losses approach 0.01 percent. The problem of occluded and surface moisture will be studied before a final certificate is issued. The effective assay is based on the sample as issued. The uncertainty indicated includes both analytical error and inhomogeneities in the material.

SRM's for Defining the pH(S) Scale

BORAX

SRM 187b, sodium tetraborate decahydrate, borax, ($30 per 30-g sample) is intended for use in defining the pH(S) scale. This lot of borax ($Na_2B_4O_7 \cdot 10H_2O$) was prepared to ensure high purity and uniformity. It meets the specifications of the American Chemical Society for reagent grade material. The water content of this salt, stored under ordinary conditions, is less than theoretical. This does not affect the use of this salt as a pH standard, but could lead to erroneous results if the partially desiccated salt were used as a boron or acidimetric standard.

SRM's 186-I-c, potassium dihydrogen phosphate, and 186-II-c, disodium hydrogen phosphate, are also intended for use in defining the pH(S) scale. The potassium dihydrogen phosphate (KH_2PO_4) and disodium hydrogen phosphate (Na_2HPO_4) meet specifications of the American Chemical Society for reagent grade materials, but should not be considered as entirely free from impurities such as traces of water, free acid or alkali, carbon dioxide, chlorides, sulfur compounds, and heavy metals.

The solution 0.025 molal with respect to both KH_2PO_4 and Na_2HPO_4 is recommended for the calibration of pH equipment. The pH(S) of this solution as a function of temperature is as follows:

°C	pH(S)	°C	pH(S)	°C	pH(S)
0	6.982	20	6.878	37	6.839
5	6.949	25	6.863	40	6.836
10	6.921	30	6.851	45	6.832
15	6.898	35	6.842	50	6.831

For pH measurements in the physiologically important range pH 7 to 8 a solution 0.008695 molal in KH_2PO_4 and 0.03043 molal in Na_2HPO_4 is also useful. The pH(S) values for this solution as a function of temperature are as follows:

°C	pH(S)	°C	pH(S)	°C	pH(S)
0	7.534	20	7.430	37	7.392
5	7.501	25	7.415	40	7.388
10	7.472	30	7.403	45	7.385
15	7.449	35	7.394	50	7.384

The potassium dihydrogen phosphate was obtained from the Mallinkrodt Chemical Works of St. Louis, Missouri; the disodium hydrogen phosphate was obtained from the J. T. Baker Chemical Co., of Phillipsburg, New Jersey.

[1] For a complete list of Standard Reference Materials available from NBS, see Catalog of Standard Reference Materials, NBS Spec. Publ. 260 (July 1970 ed.) for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for 75 cents; order by SD Catalog No. C13.10:260.

SAFETY *continued*

tained only when the intake hose of the detector was within 7 cm of the working area. When the condensation was stopped, the vapor levels returned to near zero within approximately three to four minutes, even when the condensed alloy and excess plashy amalgam were allowed to remain in place. Higher power settings and mixes containing more mercury resulted in the emission of more material.

Of the many studies conducted on the effects of mercury use in dental procedures, one of the most significant was made by Souder and Sweeney in 1931.[2] They found that there was little or no danger from mercury vapor or mercury ingestion from dental restorations of silver amalgam. In other studies it has been determined that the manipulation of mercury and the mixed amalgam will increase the mercury vapor level in the area but not enough to be considered dangerous. Other factors influencing the mercury vapor level in the working area are ventilation, number and type of sources, and the degree to which these sources are disturbed. The exact effect of each of these factors has not been definitely established. But it is agreed that the effects of long periods of exposure are not well known and therefore exposure should be kept to a minimum. The dispersion of mercury droplets and fine, partially amalgamated alloy particles in the area of operation when amalgam is condensed by ultrasonic means is undesirable. Some of the debris will be swallowed and some inhaled by the patient and the operating team. Although the amount of mercury dispersed is minimal and is not likely to cause harm to the patient, the droplets can collect in the dental operatory on such furnishings as trays, carpets, and drapes, especially if good hygiene is not practiced. It is this collection of mercury droplets that may pose a hazard to dental personnel. Whether toxic levels would be reached is not known, but certainly awareness of the potential hazard is one of the primary factors in maintaining good mercury hygiene.

[1] Chandler, H. H., Rupp, N. W., and Paffenbarger, G. C., Poor mercury hygiene from ultrasonic amalgam condensation, J. Amer. Dent. Assn. **82**, No. 3, 553-557 (Mar. 1971).

[2] Souder, W., and Sweeney, W. T., Is mercury poisonous in dental amalgam restorations? Dent. Cosmos 73:1145 (Dec. 1931).

PUBLICATIONS of the National Bureau of Standards*

PERIODICALS

Technical News Bulletin, Annual Subscription: Domestic, $3; foreign, $4. Single copy price 30 cents. Available on a 1-, 2-, or 3-year subscription basis. SD Catalog No. C13.13:55.

Journal of Research of the National Bureau of Standards

Section A. Physics and Chemistry. Issued six times a year. Annual subscription: Domestic, $9.50; foreign, $11.75. Single copy price varies. SD Catalog No. C13.22/sec.A:74.

Section B. Mathematical Sciences. Issued quarterly. Annual subscription: Domestic, $5; foreign, $6.25. Single copy, $1.25. SD Catalog No. C13.22/sec.B:74.

Section C. Engineering and Instrumentation. Issued quarterly. Annual subscription: Domestic, $5; foreign, $6.25. Single copy, $1.25. SD Catalog No. C13.22/sec.C:74.

CURRENT ISSUES OF THE JOURNAL OF RESEARCH

J. Res. Nat. Bur. Stand. (U.S.), **75A5** *(Phys. & Chem.)* (September-October 1971), SD Catalog No. C13.22/sec.A:75/5.

Ditmars, D. A. and Douglas, T. B., Measurement of the relative enthalpy of pure α-Al_2O_3 (NBS heat capacity and enthalpy standard reference material No. 720) from 273 to 1173K.

Dowling, J. A., Silverman, S., Benedict, W. S. and Quinn, J. W., A study of line shape of CO infrared emission lines.

Hellner, L. and Sieck, L. W., Kinetic mass spectrometric investigation of the reactions of t-$C_4H_9^+$ ions with some simple polar molecules at thermal energies.

MacDonald, J. R. and Powell, D. R., Discrimination between equations of state.

McMurdie, H. F., Morris, M. C., deGroot, J. and Swanson, H. E., Crystallography of some double sulfates and chromates.

Marinenko, G. and Champion, C. E., High-precision coulometric titrations of boric acid.

Meijer, P. H. E., Energy levels, wave functions, dipole and quadrupole transitions of trivalent gadolinium ions in sapphire.

Rebbert, R. E. and Ausloos, P., Ionization quantum yields and absorption coefficients of selected compounds at 58.4 and 73.6-74.4 nm.

Simmons, J. D. and Tilford, S. D., New absorption bands and isotopic studies of known transitions in CO.

Thompson, B. A. and Miller, E. C., Determination of trace elements in ruby laser crystals by neutron activation analysis.

OTHER NBS PUBLICATIONS

Bell, F. C., Wollin, H. F., Editors, Report of the 55th National Conference on Weights and Measures 1970, Nat. Bur. Stand. (U.S.), Spec. Publ. 342, 315 pages (Apr. 1971) $1.75, SD Catalog No. C13.6/3:342.

Bowman, R. R., Quantifying hazardous electromagnetic fields: Practical considerations, Nat. Bur. Stand. (U.S.), Tech. Note 389, 15 pages (Apr. 1970) 30 cents, SD Catalog No. C13.46:389.

Edgerly, D. E., Weights and Measures labeling Handbook, Nat. Bur. Stand. (U.S.), Handb. 108, 406 pages (May 1971) $3.25, SD Catalog No. C13.11:108.

Keysar, B. C., Specifications and tolerances for Reference Standards and Field Standard Weights and Measures—3. Specifications and tolerances for Metal Volumetric Field Standards, Nat. Bur. Stand. (U.S.), Handb. 105-3, 8 pages (May 1971) 25 cents, SD Catalog No. C13.11:105-3.

Risley, A. S., The physical basis of Atomic

Frequency Standards. Nat. Bur. Stand. (U.S.). Tech. Note 399, 54 pages (Apr. 1971) 60 cents. SD Catalog No. C13.46:399.

Schramm, R. E., Corrections and calculations on a x-ray diffraction line profile: A computer program. Nat. Bur. Stand. (U.S.). Tech. Note 600, 34 pages (June 1971) 40 cents. SD Catalog No. C13.46:600.

Spiegel, V., Jr., Murphey, W. M., Computer code for the calculation of thermal neutron absorption in spherical and cylindrical neutron sources. Nat. Bur. Stand. (U.S.). Tech. Note 576, 25 pages (May 1971) 35 cents. SD Catalog No. C13.46:576.

NBS OFFICE OF STANDARD REFERENCE DATA BIBLIOGRAPHY SERIES

The following OSRDB Bibliography Series are available by purchase from the National Technical Information Service (NTIS), Springfield, Va. 22151 at the prices indicated.

NBS-OSRDB-70-1-V1 (PB191174), High Pressure Bibliography 1900-1968, Volume I. Section I— Bibliography. Section II—Author Index, by Leo Merrill, April 1970, $7.

NBS-OSRDB-70-1-V2 (PB191175), High Pressure Bibliography 1900-1968, Volume II—Subject Index, by Leo Merrill, April 1970, $7.

NBS-OSRDB-70-3 (AD705110), Semiempirical and Approximate Methods for Molecular Calculations—Bibliography and KWIC Index, by George A. Henderson and Sandra Frattali, December 1, 1969, $3.

NBS-OSRDB-70-4 (COM 71-00025), Bibliography of Photoabsorption Cross Section Data, by Robert D. Hudson and Lee J. Kieffer, October 1970, $4.

NBS-OSRDB-71-1 (COM 71-00248), Bibliography on Properties of Defect Centers in Alkali Halides, S. C. Jain, S. A. Khan, H. K. Sehgal, V. K. Garg, and R. K. Jain, January 1971, $3.

PUBLICATIONS IN OTHER JOURNALS

This column lists all publications by the NBS staff, as soon after issuance as practical. For completeness, earlier references not previously reported may be included from time to time.

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